

Project Category: Cross-Ecosystems (Forest Ecosystems and Freshwater)

Project Title: *A Conservation Priorities Tool for the North Pacific LCC*

Project Leader or Principal Investigator responsible for completion of project:

- Allison Bidlack, Ph.D., Science Coordinator, Copper River Program, Ecotrust. abidlack@ecotrust.org | 907-424-3541.
- Mike Mertens, Director of Spatial Analysis, Ecotrust. mikem@ecotrust.org | 503-467-0775

Cooperators/Partners and anticipated project contributions: **1) Neil Hughes**, Forestry Program Director, Ecotrust Canada. neil@ecotrust.ca | 604-682-4141 x237. Canadian data collection and key stakeholder engagement. **2) Dan Shively**, Fish Passage and Habitat Partnerships Coordinator, US Fish & Wildlife Service, Region 1, Fisheries Resources. Dan_Shively@fws.gov | 503-231-2270. Agency stakeholder engagement and data identification. **3) Lee Benda, Ph.D.**, Scientist, Earth Systems Institute. leebenda@earthsystems.net | 206-633-1792. Dr. Benda developed the NetMap platform for watershed analysis, and in conjunction with this project, will complete the Alaskan coverage of the NPLCC geographic area.

Project Summary: Ecotrust proposes to develop an open source, spatially explicit, conservation and restoration priorities tool that will assist the North Pacific LCC and other natural resource managers, individuals, and community organizations in accessing disparate data sources for understanding and visualizing the potential effects of climate change on freshwater and forest ecosystems throughout the North Pacific LCC geographic area. This tool will leverage significant resources spent to develop the codebase for MarineMap (www.marinemap.org) and will build on a conservation priorities tool currently under development for the US Fish and Wildlife Service that helps users identify regional freshwater conservation and restoration priority areas in the Pacific Northwest (Oregon, Washington and Idaho) given the potential impacts of climate change and aquatic invasive species. We propose to expand this tool to include additional terrestrial species of interest and increase the geographic scope to include the entire North Pacific LCC geographic area.

Project Proposal:

Background and Need - Uncertainties exist about the extent and intensity of climate change impacts in our region. Scientists are working to understand climate change and its effects on the landscape even as managers and policymakers must respond to those effects as they occur and in their short- and long-term planning (Overpeck et al. 2011). Currently, regional landscape-level climate change data is scattered, little of it is easily viewable, and much of it resides in the academic and research domain (e.g., Oregon State University's PRISM Climate Group (2010); University of Alaska's Alaska Center for Climate Assessment and Policy (2011) ; University of Washington's Climate Impacts Group (2011). Furthermore, there is limited access to regional, standardized, easy-to-use visualization and management tools designed to apply state-of-the-art knowledge to real projects on the ground. Our Decision Support Tool will fill that gap by providing free, online access to the most current and credible climate change, watershed condition, freshwater, and forest system data.

Climate change strategies and research commonly identify the need for collaborative, regional action across political and jurisdictional boundaries (Defenders of Wildlife and ODFW 2008; Heller and Zavaleta 2009; Littell et al. 2009; Furniss et al. 2010; USFWS 2010). The sharing of data and analysis is a fundamental component of this collaborative process. The complexity of climate change data and its strong foundation in the academic realm limit its easy accessibility. A recent report in Science (Overpeck et al. 2011) recognizes the need for readily available climate data that are useful and understandable by broad, interdisciplinary audiences. The authors recommend a "new paradigm" of open, user-friendly access to climate data as scientific and public users of that data increase along with its volume and complexity. Furthermore, the Oregon Global Warming Commission (Defenders of Wildlife and ODFW 2008) recognizes that fish and wildlife managers will require better access to existing information on climate change and its impacts in order to respond to the increasing uncertainties of management in the face of climate change. They identify regional-scale assessments of species and ecosystem vulnerability as a major need in order to support prioritization and management decisions.

The U.S. Fish and Wildlife Service (2010) adopts adaptation and engagement strategies in its Strategic Plan for Responding to Accelerating Climate Change. Adaptation goals and objectives include acquiring and applying the best climate change science to planning and conservation design, as well as fostering partner collaboration and coordination. To support its engagement strategy, USFWS proposes developing “useful and accessible information resources” to engage and share climate change information, education and training with Service employees internally as well as, local, state, national, and international partners, both public and private. The development of this tool will support those goals.

Federal, State and local land managers and land management agencies are increasingly interested in identifying priority habitat and ecosystems at multiple scales, and the ability to assess these priorities with respect to vulnerabilities such as threats imposed by the potential effects of climate change. However, their efforts to do so are hampered by a lack of appropriate tools and access to the latest and best region wide data sets, in particular, data sets pertaining to climate change. Managing for multiple objectives requires new data, as well as the ability to compile, sort, and quantitatively analyze them, particularly with respect to tradeoffs and synergies among a diverse set of objectives.

Natural resource planners currently have very limited access to the myriad current data sets generated by universities, government agencies, non-profits and other NPLCC stakeholders. Without easy access and the ability to interpret these data, stakeholders interested in addressing restoration and conservation issues are at a disadvantage. We will address this problem by developing a web based Decision Support Tool (DST) that allows users to access and visualize the most current sets of natural resource and climate change data in one common, spatially explicit framework.

Utilizing the codebase developed as part of the MarineMap (www.MarineMap.org) framework, we have begun to implement a DST for terrestrial ecosystems through a collaboration with the US Fish and Wildlife Service (USFWS) Region 1. We are working with the USFWS to develop an open source, conservation prioritization tool for restoration actions that takes into account the potential impacts of climate change and aquatic invasive species on watershed condition and focal species. This tool will be freely available on the web to conservation and restoration planners. By building on this effort, we take advantage of a codebase that is well established and tested, with a proven track record of success in major planning efforts.

Tighter government budgets dictate that resource managers become more efficient and directed in using funds for management actions. This tool will assist managers in prioritizing conservation and restoration work. Using the tool, managers will be able to visualize spatially explicit data from disparate sources at different geographic scales across the NPLCC region. In addition to data visualization, users will be able to run analyses that prioritize specific areas based on users’ specified objectives. Users will be able to visualize map based and graphical results in real time and can then make changes “on the fly” by rerunning various scenarios. The online, open source nature of the tool allows stakeholders to use the tool in their offices or in large group settings without the need for expensive software licenses. Sessions can be saved and shared with different user groups, facilitating dynamic, multi-stakeholder decision making.

We will create an open-source Decision Support Tool, freely available online, where climate and natural resource conservation data can be readily visualized, explored, and shared. This dynamic tool will give users the ability to instantly identify climate change vulnerability and visualize the results of a range of assumptions by running analyses based on users’ selection of input parameters. This Decision Support Tool will advance resource conservation by fostering the collaboration and communication of scientists, policy-makers, natural resource planners and managers, and landowners.

Methods: Our approach entails five sequential tasks including: 1) stakeholder engagement and user needs assessment; 2) review of existing data and analytical approaches; 3) compilation and standardization of data; 4) tool development and; 5) documentation and release. Each task is briefly discussed below.

The stakeholder engagement process (task 1) is an essential step in identifying user needs and preferences and will ultimately inform all subsequent tasks. This task includes meeting with NPLCC stakeholders to demonstrate

existing tools (USFWS aquatic priorities tool and MarineMap) and share project goals and objectives as well as receive input on project direction and priorities. We will incorporate NPLCC stakeholder feedback into development of analytical approaches, data sources, and final product.

Data and methods review (task 2) includes a census of all existing climate change and natural resource conservation data and sources and a review of existing regional climate change vulnerability approaches. We will follow the same three-pronged approach used in our current work with USFWS for identifying pertinent data sets, including identifying and mapping priority species, watershed condition, and potential climate effects. In this way, we can focus on long-term conservation goals while also identifying areas vulnerable to the most pressing regional threats. We have already collected over 100 data sets related to these components and will draw on the expertise of Ecotrust's Alaska program staff and Ecotrust Canada staff to help us identify and compile data necessary to extend the geographic scope of the tool to cover the entire North Pacific LCC geographic area. While this task includes an extensive review of existing data, a few potential data sources are identified below.

Existing and potential data on widespread, migratory fish include: ODFW; WADFW: Anadromous Fish Distribution 2010; ADF&G; CaDFG ; StreamNet; CRITFC; NOAA; and Ecotrust's State of the Salmon program. Geospatial data on locally endemic species and for terrestrial species can be more difficult to obtain. For the conterminous United States, NatureServe publishes distribution data by watershed (NatureServe 2004). For British Columbia, Natural Resources Canada (2009) maintains geospatial data specific to land cover. For Alaska, AKDNR (2011) and the Alaska Natural Heritage Program (2011) maintain data specific to land cover, terrestrial species and threatened and endangered species. Finally, the California Department of Fish and Game (2011) maintains the California Natural Diversity Database.

Downscaled climate projections are available, but are scattered and limited to varying geographic areas. Some states make this data available (Oregon Geospatial Data Clearinghouse: Average Monthly or annual precipitation, minimum and maximum temperature, 1971-2000). Regionally, the Climate Impact Group (n.d.) provides a wealth of information and spatial data for the Columbia River Basin. While difficult to find on their website, we have obtained data on predicted air temperature, precipitation, and snow-water equivalent (SWE). In Alaska, both the University of Alaska (2011) and the Alaska Center for Climate Assessment and Policy (2011) maintain extensive Alaska satellite and GIS and downscaled climate prediction models. Finally, the University of Victoria maintains regional climate change data for British Columbia and parts of the Yukon as part of the Pacific Climate Impacts Consortium (2011).

Datasets that will be useful in measuring watershed condition include land use and land cover, roads, and environmental quality, among others. Some states make this data available; Oregon's Geospatial Data Clearinghouse distributes an ecological systems dataset (Kagan 2010) as well as roads and railroads. Washington State makes land use, water quality assessment (WSDOE 2011), and transportation data (WSDOT 2010) available. National datasets for the United States that may be useful include the Wildland Urban Interface (CONUS only) and the Protected Areas Dataset 1.1 (CBI 2010). The National Land Cover Database (MRLC 2011) has recently been updated for 2006, and includes land cover, land cover change, and imperviousness data. Additionally, Natural Resources Canada (2009) maintains geospatial data specific to land cover. NetMap (Earth Systems Institute 2011) is a powerful watershed analysis platform that will support and inform the analysis of watershed condition, within its current geographic scope in the U.S portion of the NPLCC geographic area.

Once all data are identified we will compile both spatial and non-spatial data within the geo-spatial framework and pre-process compiled GIS data in preparation for inclusion in tool (task 3). Both the staff of Ecotrust's Alaska program, including co-PI Allison Bidlack, and Ecotrust Canada will play a major role in data compilation and standardization.

Development of an automated, online, open-source analytical tool (task 4) includes both 1) construction of an automated model that allows for manipulation of key parameters and rapid (real-time) assessment of data given approaches specified through task 2; and 2) customized development of an existing online, spatially explicit, open source tool that facilitates stakeholder interaction (including alpha, beta and final releases). As mentioned above, this task consists of customization of the MarineMap codebase and adaptation of the USFWS aquatic diversity

tool. Construction of the automated model includes: server-side modeling including conversion of sample data to input formats; calibration; and integration of results including asynchronous model execution, data translation, and reporting outputs. Customized development of the tool includes: creation of a new instance of MarineMap codebase; client-side project specific UI adjustments; deployment on a production server; implementation (with new data layers, new input widgets, analysis module and KML output) and; cross-browser testing for functionality and data accuracy testing.

Finally, the tool and any findings will be made available for public use (task 5). This task will include creation of a short tutorial video that demonstrates use of tool, creation of detailed metadata and documentation of individual data layers, the decision making process, and the modeling approach; publication of a public, online version of the tool that allows for visualization of inputs and priorities resulting from the process; and licensing the tool under an open source license agreement (GPL) and making the source code available.

Geographic Extent: The geographic extent of this work will include the entire geographic area of the North Pacific LCC.

Timeline of Schedules, Products and Outcomes: Stakeholder meetings will take place in the first three months of the project and will result in a detailed user needs assessment and engagement process. Based on this input, a detailed software specification will be developed and data compilation and tool development will commence. The software design includes an alpha, beta, and final release with significant time for testing and validation. Major milestones include:

- September 30: Comprehensive list of all potential data sources to be vetted with NPLCC partners
- October 15: Software specification document
- January 31: Alpha release
- March 31: Beta release
- April 30: Final release
- June 30: Final documentation and licensing of the tool
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Task	Month											
	J	A	S	O	N	D	J	F	M	A	M	J
1) Stakeholder engagement process												
Determine goals, objectives, and project priorities												
Demonstrate tool and solicit feedback												
2) Review of existing data and approaches												
Review existing climate change vulnerability approaches												
Review climate and conservation data and sources												
Approaches vetted with NPLCC												
3) Compilation and standardization of data												
Compile spatial and non-spatial data												
Standardize data across region												
Pre-process GIS data												
4) Development of analytical framework												
Construct automated model												
Development of an online tool												
5) Make tool and findings available for public use												
Create detailed metadata and documentation												
Publish online version of the tool												
License tool												

Budget: See attached.

Disclaimer regarding Data Sharing: Any data generated by Ecotrust will be made freely available through the Decision Support Tool. Data collected from other sources will be cited and permission gained from the originator for free distribution.

Literature Cited

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- Overpeck, JT, GA Meehl, S Bony, and DR Easterling. 2011. Climate Data Challenges in the 21st Century. *Science* 331, no. 6018 (February 11): 700 -702. doi:10.1126/science.1197869.

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Radeloff, V.C., R.B. Hammer, S.I. Stewart, J.S. Fried, S.S. Holcomb, and J.F. McKeefry. 2005. WUI maps, statistics, and GIS data library. SILVIS Lab, University of Wisconsin. <http://silvis.forest.wisc.edu/old/Library/WUILibrary.php>.

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University of Alaska. 2011. GINA - Alaska Satellite and GIS Data - Geographic Information Network of Alaska. Geographic Information Network of Alaska. January 28. <http://www.gina.alaska.edu/>.

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Washington State Department of Transportation (WSDOT). 2010. WSDOT GeoData Distribution Site (GIS data for maps). Washington Department of Transportation. <http://www.wsdot.wa.gov/mapsdata/geodatacatalog/default.htm>.

Ecotrust: A Conservation Priorities Tool for the North Pacific LCC

Budget period: July 1, 2011 - June 30, 2012

Total funds requested: \$ **95,700**

Budgeted Expenses

Salaries	\$	47,800
Fringe		15,300
Conferences and meetings		2,000
Subgrants		8,000
Travel		6,500
Printing and publications		1,500
Direct allocations		4,700
Indirect costs		9,900
Total Expenses	\$	95,700

Leveraged Funds:

The proposed work will directly build upon and be leveraged by two current Ecotrust DST development projects: 1) Development of a DST for USFWS Region 1 to help identify regional freshwater conservation and restoration priority areas in the Pacific Northwest (Oregon, Washington and Idaho) given potential impacts of climate change and aquatic invasive species. This work is supported by a grant of \$130,000 from USFWS. 2) Development of MarineMap, a web-based interface that allows scientists, fishers, and other users to create, compare, and analyze alternative marine spatial planning proposals. MarineMap's development and refinement to date have been supported by over \$1 million of investments from government and private philanthropic funding sources. Through these projects we have already established a strong foundation of data, contact networks, and potential approaches that will support our work for the NPLCC. We will build the NPLCC decision support tool on MarineMap's tested and proven framework, a substantial savings of time and resources.

Budget Narrative:

Salaries - Ecotrust will dedicate approximately .85 full-time equivalent (FTE) staff to project activities. Some variation between staff may occur, but budgeted allocations are as follows: .15 FTE co-PI Allison Bidlack, Science Coordinator; .15 FTE co-PI Michael Mertens, Director of Spatial Analysis/GIS Manager; .35 FTE Jocelyn Tutak, GIS Analyst; and .20 FTE Scott Fletcher, Applications Developer.

Fringe - Fringe benefits include health, dental and vision insurance, FICA, retirement, and disability and are calculated at 32% of personnel.

Conferences and meetings - Supply and logistics costs associated with hosting 3-5 stakeholder meetings in locations throughout the NP LCC geography.

Subgrants - Subgrant to Ecotrust Canada for assistance with accessing and compiling relevant Canadian data sources, equivalent to approximately .15 FTE staff time.

Travel - Staff travel, including roundtrip airfare, mileage, meals, and lodging, to host 3-5 stakeholder meetings in locations throughout the NP LCC geography.

Printing and publications - Publication of project methods documentation and outreach materials.

Direct allocations - Includes direct allocations for costs directly attributable to project delivery including telephone and internet, occupancy, insurance, depreciation, and office supplies.

Indirect costs - Indirect costs are calculated using Ecotrust's federally-approved rate for indirect charges of 15.65% applied to a base of total direct salaries and wages, including fringe benefits.

Allison Lynn Bidlack
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Cordova, Alaska 99574
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Professional Experience

Science Coordinator, Ecotrust Copper River Program (2009 – present)

Research program administration, grant-writing, field work management

Contractor, Ecotrust Copper River Program (2008)

Knowledge system (GIS) administration, grant writing, hatchery salmon straying field work management

Graduate Student Instructor, *Wildlife Ecology*, University of California, Berkeley (2007)

Taught undergraduates wildlife ecology concepts, led discussions, graded papers, created labs and problem sets

Graduate Student Instructor, *Conservation Biology*, University of California, Berkeley (2003)

Taught undergraduates conservation biology concepts, graded papers, created labs and problem sets

Instructor, *Molecular Genetic Methods*, University of Alaska Fairbanks (2001)

Independently developed and taught a hands-on upper-level course on molecular laboratory methods

Laboratory Manager, Core Facility for Nucleic Acid Analysis, University of Alaska Fairbanks (2000-2001)

Maintained instruments, processed samples, provided PCR and sequencing expertise to users, ordered supplies, and managed accounts

Research Assistant, University of Alaska Museum (1998-2000)

Trapped small mammals in southeast Alaska, British Columbia and Yukon; prepared museum specimens

Graduate Teaching Assistant, *Biochemistry & Genetics*, University of Alaska (1997-1998)

Taught undergraduates the basics of biochemistry and genetics, graded papers, led discussions, created problem sets and exams

Environmental Paralegal, Burns & Levinson, Boston, Massachusetts (1994-1995)

Researched law relevant to wetlands, air quality, and hazardous waste; investigated property histories; drafted reports, letters and memoranda for attorneys; and managed case files and accounts

Wildlife Technician, USDA Forest Service, Yakima, Washington (1993)

Assessed small mammal diversity and abundance using mark-recapture techniques, surveyed vegetation transects and trapping grids, and collected data on habitat floral composition

Education

Ph.D. University of California, Berkeley (2007) - Environmental Science, Policy and Management

Drs. Wayne Getz and Adina Merenlender, advisors

M.S. University of Alaska Fairbanks (2000) - Biology

Dr. Joseph A. Cook, advisor

B.S. University of Michigan (1992, with distinction) - Resource Ecology and Management

Publications

Bidlack AL, Merenlender A and Getz WM. 2007. Distribution of non-native red foxes in East Bay oak woodlands. *In* Proceedings of the 6th California Oak Symposium: Today's Challenges, Tomorrow's Opportunities. USDA Forest Service General Technical Report.

Bidlack AL, Reed SE, Palsbøll PJ and Getz WM. 2007. Characterization of a western North American carnivore community using PCR-RFLP of cytochrome *b* obtained from fecal samples. *Conservation Genetics* 8:1511-1513.

Bidlack AL and Cook JA. 2002. A nuclear perspective on endemism in northern flying squirrels (*Glaucomys sabrinus*) of the Alexander Archipelago, Alaska. *Conservation Genetics* 3:247-259.

Cook JA, **Bidlack AL**, Conroy CJ, Demboski JR, Fleming MA, Runck AM, Stone KD and MacDonald SO. 2001. A phylogeographic perspective on endemism in the Alexander Archipelago of Southeast Alaska. *Biological Conservation* 97:215-227.

Bidlack AL and Cook JA. 2001. Reduced genetic variation in insular northern flying squirrels (*Glaucomys sabrinus*) along the North Pacific Coast. *Animal Conservation* 4:283-290.

Manuscripts in Preparation

Bidlack AL, Reed SE, Merenlender A and Getz WM. Distribution and habitat use of non-native red foxes (*Vulpes vulpes*) in the San Francisco Bay Area. Target journal: Journal of Wildlife Management
Arbogast BS, **Bidlack AL**, Kenagy J and Cook JA. Paleodemography and post-glacial expansion of the northern flying squirrel, *Glaucomys sabrinus*. Target journal: Evolution

Professional Presentations

“Distribution of non-native red foxes in East Bay oak woodlands,” 6th California Oak Symposium, Rohnert Park CA, October 2006
“Assessing San Joaquin kit fox population dynamics using long-term datasets,” 8th Annual Bay Area Conservation Biology Symposium, San Francisco CA, February 2006
“Phylogeography and population genetics of northern flying squirrels (*Glaucomys sabrinus*) in Southeast Alaska,” Wildlife and Conservation Biology Seminar Series, University of California, Berkeley, Spring 2002
“Population genetics of an island endemic, the Prince of Wales flying squirrel (*Glaucomys sabrinus griseifrons*),” American Society of Mammalogists Annual Meeting, Durham NH, June 2000

Field Work

San Joaquin kit fox spotlighting surveys, Carrizo Plain National Monument, California, 2006-2007
Carnivore scat surveys, northern California, 2004-2006
Small mammal trapping and collection, Kings Canyon and Yosemite National Parks, California, 2003
Small mammal trapping and collection, Alaska, British Columbia, and Yukon, 1997-1999
Small mammal mark-recapture surveys, Yakima Firing Range, Yakima, Washington, 1993
Ground squirrel mark-recapture study, Grand Teton National Park, Wyoming, 1990

Service Activities

Reviewer, Journal of Mammalogy, Oecologia, Animal Behaviour (2004-2007)

Critically reviewed and edited manuscripts submitted for publication

Scientific Consultant, Center for Biological Diversity (2005)

Assisted in preparation of “Petition to List the Fisher (*Martes pennanti*) as Endangered” under California ESA

Graduate Student Mentor, University of California, Berkeley (2004-2005)

Assisted undergraduate with her senior thesis research planning, implementation, and analysis

Organizing Committee Member, 5th Annual Bay Area Conservation Biology Symposium (2003)

Secured site and permits for meeting, obtained catering and audio-visual services, organized plenary speakers and managed meeting volunteers

Co-President, Berkeley Chapter of the Society for Conservation Biology (2002-2003)

Organized monthly meetings with guest speakers, planned field trips and fundraising events, and overhauled chapter by-laws

Professional Society Memberships

American Society of Mammalogists

Society for Conservation Biology

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Portland, Oregon 97209
503-467-0775
mikem@ecotrust.org

Professional Experience

Director of Spatial Analysis/GIS manager, Ecotrust, Portland, Oregon (2005 – present)

- Responsible for maintaining and strengthening the organization's overall technical geographic information system capacity. Responsible for supervising all GIS staff, including GIS analysts, technicians, interns and volunteers, including Portland and field based GIS staff. Works with the Vice President of Knowledge Systems and other senior staff to allocate these staff to projects and programs based on priority needs. Primary liaison with other internal staff and staff of affiliate organizations for GIS services.
- Manager of Ecotrust Consulting Initiatives serving mapping needs of multiple clients.
- Responsible for development of organization's standard operating procedures pertaining to information services including protocols on data access and storage, nomenclature, cartographic design, reporting and documentation, quality control / quality assurance and appropriate performance and capacity planning.

Adjunct Faculty, Portland State University, Portland, Oregon (2006 – present)

- Instructor of graduate level class on theory and application of Geographic Information Systems. Four credit course with approximately 50 students / term.

GIS manager and Senior GIS Analyst, Ecotrust, Portland, Oregon (2001 – 2005)

- Worked laterally with other staff to provide the best support to the organization in obtaining, publicizing, categorizing, evaluating quality, transforming, analyzing, and making appropriate use of data resources needed by the organization. Oversaw development and deployment of enterprise-wide SDE
- Represented Ecotrust's interests in negotiations with vendors and partners regarding data sharing and licensing agreements. Ensured that program complies with Ecotrust policies and procedures and external (donor/legal) requirements.

Senior Information Analyst/Programmer, Ecotrust, Portland, Oregon (1998 – 2002)

- Principal Investigator and lead analyst on classification of forest composition and structure for the coastal temperate rainforest of North America using remotely sensed information, geographic information systems and multivariate statistical analysis.
- Principal analyst on Siuslaw watershed assessment. Provided all mapping, and spatial analysis. Coordinated data development. Co-author of assessment document.
- GIS and remote sensing analyst on project with Metro to map forest canopy cover, land cover, and natural areas in the greater Portland Metropolitan area using Landsat TM satellite imagery and other ancillary data.

GIS Analyst, Interrain Pacific, Pacific GIS Portland, Oregon (1995 – 1998)

- Responsible for construction and maintenance of Internet based Bioregional Information System (<http://www.Inforain.org>) including development of multiple on-line interactive mapping applications. Management of active web pages for searching, viewing and downloading data through form based queries.
- Developed custom comprehensive mapping and information retrieval application distributed with the Tualatin River Watershed Information System CD-ROM for accessing GIS data. Also responsible for database design, data compilation and creation, data documentation and analysis of GIS data for the CD-ROM.

Education/Training

B.S. Humboldt State University, Arcata, CA (1994) – Natural Resource Planning / Geography.

Ph.D. Student, Portland State University – Regional Sciences

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